**AS Unit BY2: Biodiversity and Physiology of Body Systems**

|  |  |
| --- | --- |
| Name: | Date: |

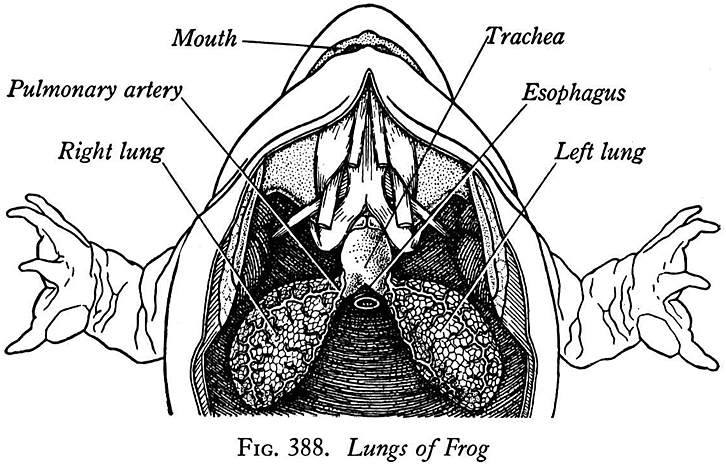
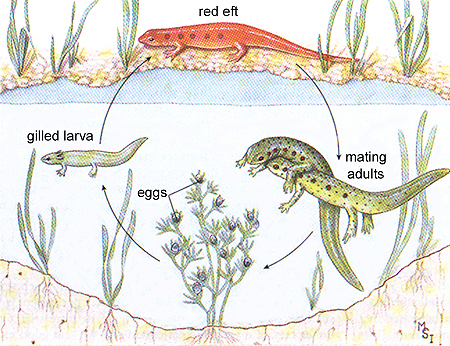
**Topic 2.2 Adaptations for Gas Exchange** – Page 2

|  |  |  |
| --- | --- | --- |
|  |  | Completed |
| 1. | Read page 2 and 3 about gas exchange surfaces in amphibians, birds and reptiles.   * Complete the question on page 2 |  |
| 2. | Label the human respiratory system on page 4. |  |
| 3. | Read and complete the activities on pages 5 to 8. |  |
| 4. | Read Toole and Toole ‘Understanding Biology’ page 399-403  Answer the following questions from Toole and Toole p410-411  Question 1; 2a,b and c only and 3. |  |

**Gas exchange in other animals**

Air has a higher concentration of oxygen compared to water. However, it is difficult keeping the respiratory surface moist in air. Most animals have adapted by having the respiratory surface deep in the body, such as the lungs in humans. In addition to minimising water loss it also helps to minimise heat loss.

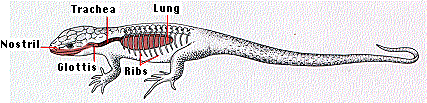
**Amphibians**

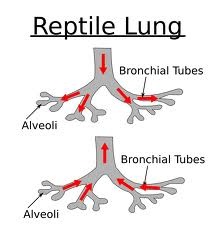


Amphibians have a larval form that is based in water. The larval form of amphibians uses gills. The adult form uses its moist skin as a respiratory surface whereas active adults will use lungs. The lungs of an adult are internal, simple and sac like.

Explain why the moist skin would not be able to supply the gas exchange needs of an active adult?

**Reptiles**

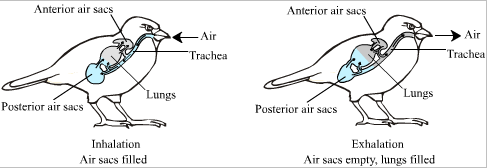




Reptiles have complex internal lungs which are protected by a rib cage. The rib cage and its associated muscles help with the ventilation of the lungs.

The looks are more complex and folded compared to amphibian lungs, this helps with increasing the surface area for gas exchange.

**Birds**



Birds have lungs, but they also have air sacs. Depending upon the species, the bird has seven or nine air sacs.

**Birds** do not have a diaphragm; instead, air is moved in and out of the respiratory system through pressure changes in the air sacs. Muscles in the chest cause the sternum to be pushed outward. This creates a negative pressure in the air sacs, causing air to enter the respiratory system. Expiration is not passive, but requires certain muscles to contract to increase the pressure on the air sacs and push the air out. Because the sternum must move during respiration, it is essential that it is allowed to move freely when a bird is being restrained. Holding a bird "too tight" can easily cause the bird to suffocate.

Respiration in birds requires two respiratory cycles (inspiration, expiration, inspiration, expiration) to move the air through the entire respiratory system. In mammals, only one respiratory cycle is necessary.

The air sacs function like bellows pumping air into the lungs.

**Human Respiratory System**

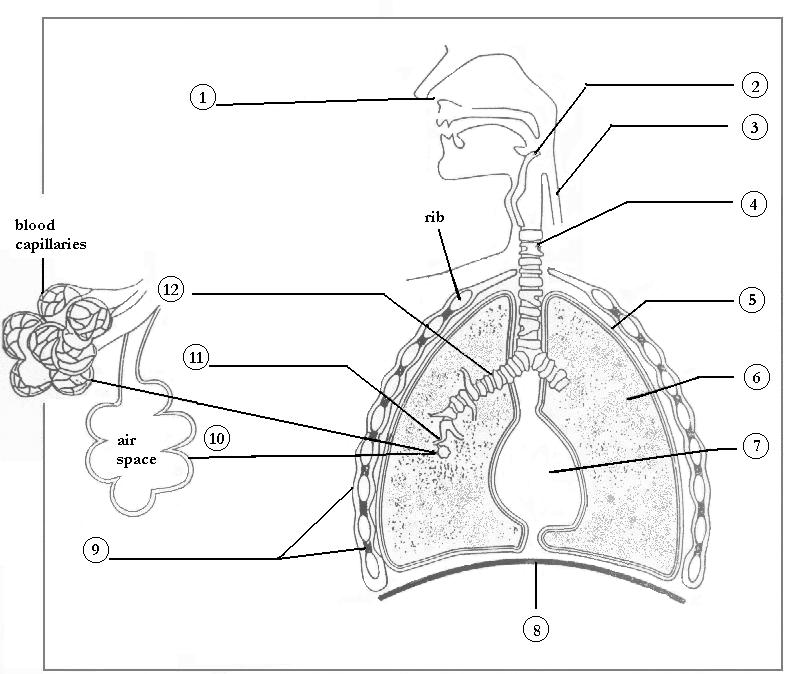
In humans **muscular movements where air with a relatively high oxygen concentration is taken into our thoracic cavity and air with a relatively high carbon dioxide concentration is removed cause ventilation**. Oxygen and carbon dioxide diffuse into and out of the blood at the respiratory surfaces in the lungs; this is known as **gaseous exchange**.

**Note**: Chemical reactions in all living cells in which food is broken down to release energy using oxygen in the process is known as **respiration**, do not confuse this with gas exchange or ventilation!

**The Structure of the Human Gas Exchange System**

Air enters and leaves the body via the nose and mouth. It travels along a series of tubes to get to the lungs. The lungs are situated in the thorax (chest cavity). They are protected by the ribs and sternum (breastbone). Label the diagram below:

Nasal cavity / Gullet / Pleural membrane / Heart / Intercostal muscle / Bronchiole / Epiglottis / Trachea / Left lung / Diaphragm / Alveolus / Bronchus



Each lung is surrounded by an air-tight cavity called the pleural cavity. This is bounded by two membranes, or pleura, which secrete pleural fluid into the cavity. The fluid is a lubricant, preventing friction when the lungs expand at inspiration. Pressure is always 500KPa lower than in the lungs and this allows them to expand and fill the thorax.

What is a more common name given to the larynx?

The alveoli are the delicate air sacs found at the end of the bronchioles and are the site for gas exchange.

Gas exchange is the transfer of gases between an organism and its environment. In humans oxygen is taken in and carbon dioxide is given out.

The alveoli need to be adapted so that gas exchange is quick and efficient. The diffusion distance between the inside of the alveolus and the bloodstream needs to be short. There needs to be a good blood supply to and from the alveoli which will help to maintain the concentration gradient for the two gases.

|  |
| --- |
| 5 |

* On the right hand side diagram label the alveolus wall and the walls of three capillaries.

1. For gases to diffuse into or out of the blood, through how many cells do they have to diffuse?

Therefore the **diffusion distance is very short**, speeding up the exchange of gases.

1. A **dense network of blood capillaries** surrounds each alveolus. How will this help gas exchange?

Each capillary surrounding each alveolus is fed with blood coming from the pulmonary artery.

1. What can you say about the concentrations of oxygen and carbon dioxide in the blood?

1. Blood leaving the alveoli will feed into which blood vessel?

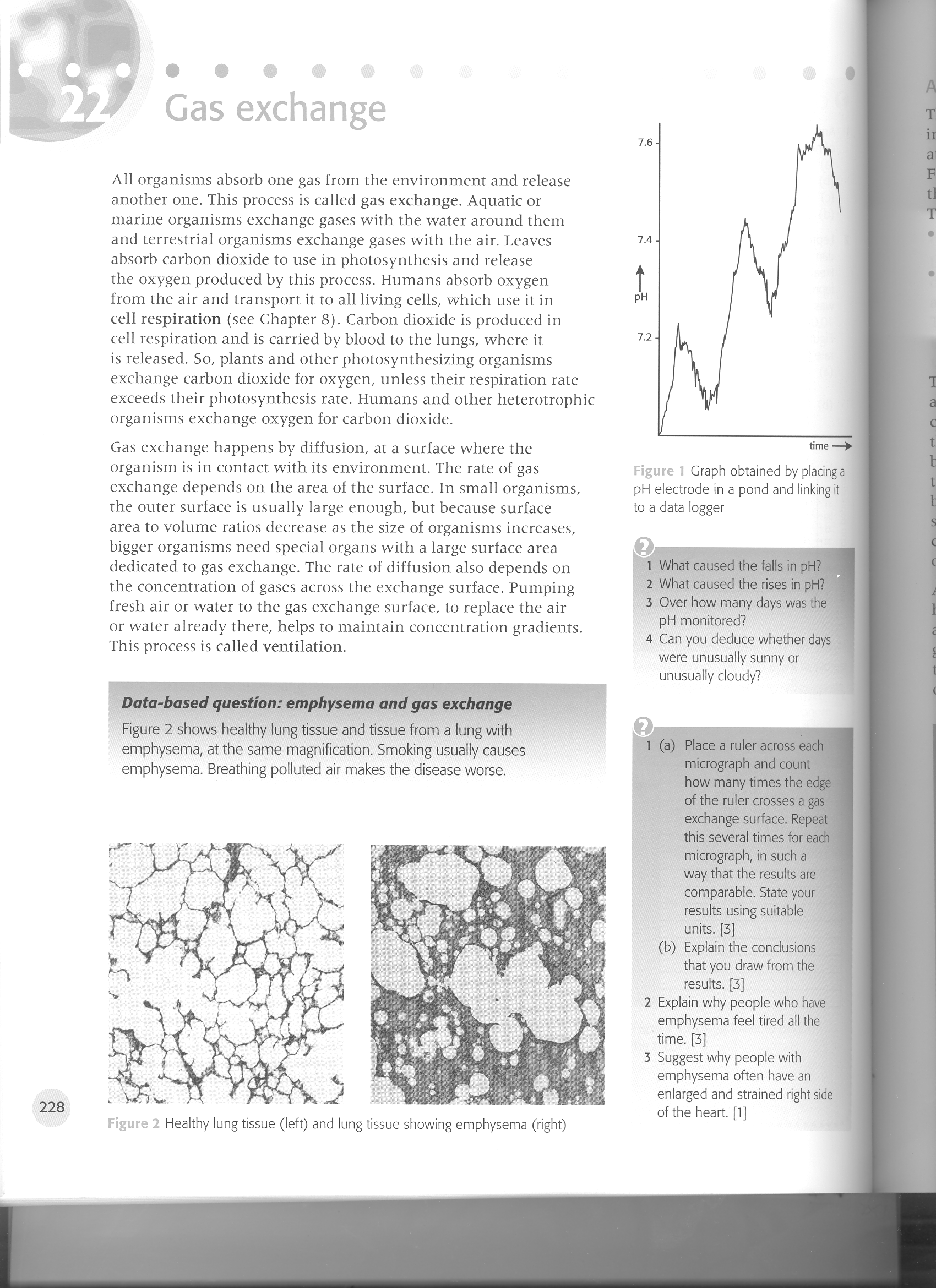
The maintenance of **high concentration gradients** for carbon dioxide and oxygen ensures efficient gas exchange.

The walls of the alveoli secrete a **detergent-like substance** that stops the alveoli sticking together when the lungs deflate.

There are millions of small alveoli in the lungs and these provide a **large surface area** for gas exchange.

**Activity:**

The figure below shows healthy lung tissue (left) and tissue from a lung with emphysema. They are both taken at the same magnification.



1. Place a ruler across each micrograph and count how many times the edge of the ruler crosses a gas exchange surface. Repeat this several times for each micrograph so that you can obtain comparable and meaningful results.

2. State your results using suitable units.

3. What conclusions can you make from your results?

1. Explain some of the symptoms you think would be felt by an emphysema sufferer.

Below is a simplified diagram of the muscles found between the ribs called the intercostal muscles. As with all muscles they work in pairs, as one contracts the other relaxes and vice versa.

|  |
| --- |
| 5 |

1. Name the two antagonistic muscles:

1. Looking closely at the diagram predict which way the rib cage will move when the external intercostal muscles contract.

1. Predict which way the rib cage will move when the internal intercostal muscles contract.

The diaphragm is a dome shaped tough sheet of connective tissue and is attached to the thoracic cavity by muscle. When this muscle contracts it becomes flatter..

|  |
| --- |
| 5 |

1. Label the diaphragm muscle and the intercostal muscles on the previous diagrams.

If air is to be brought into the lungs then the air pressure inside the lungs has to be lower than the air pressure outside the lungs. If air is to be expelled from the lungs then the air pressure inside the lungs has to be higher then the air pressure outside the lungs.

These pressure changes are brought about by changing the volume of the thoracic (chest) cavity. If the volume is increased then the pressure will be decreased and vice versa.

The volume changes are brought about by the action of the intercostals muscles and the diaphragm muscle.

1. Look at the pairs of statements below and decide which goes into which column:

|  |  |
| --- | --- |
| **When we breathe in:** | **When we breathe out:** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

* External intercostal muscles contract / External intercostal muscles relax
* Internal intercostal muscles relax / Internal intercostal muscles contract
* Rib cage lifts up and out / Rib cage moves down and in
* Diaphragm muscle contracts / Diaphragm muscle relaxes
* Diaphragm becomes dome shaped / Diaphragm becomes flatter
* Volume inside the thoracic cavity increases / Volume inside the thoracic cavity decreases
* This causes air pressure inside the thoracic cavity to increase / This causes air pressure inside the thoracic cavity to decrease
* Air is drawn into the lungs to equalize the pressure difference / Air is forced out of the lungs to equalize the pressure difference

**Review Sheets**

